IS 4545-3 (1983): Methods of measurement on receivers for television broadcast transmissions, Part 3: Geometrical properties of the picture [LITD 7: Audio, Video and Multimedia Systems and Equipment]

BLANK PAGE

(Reaffirmed 2003)

Indian Standard

METHODS OF MEASUREMENT ON RECEIVERS FOR TELEVISION BROADCAST TRANSMISSIONS

PART 3 GEOMETRICAL PROPERTIES OF THE PICTURE

(First Revision)

UDC 621·397·62 : 621·391·837·08

INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 6

May 1986

Indian Standard

METHODS OF MEASUREMENT ON RECEIVERS FOR TELEVISION BROADCAST TRANSMISSIONS

PART 3 GEOMETRICAL PROPERTIES OF THE PICTURE

(First Revision)

Radio Communications Sectional Committee, LTDC 20

Chairman	*Representing*
SHRI H. S. JOLLY	All India Radio, New Delhi
Members	
SHRI O. P. KHUSHU (*Alternate* to Shri H. S. Jolly)	
ADDITIONAL DIRECTOR STANDARDS (S & T)	Ministry of Railways (RDSO)
JOINT DIRECTOR STANDARDS (S & T) - IV (*Alternate*)	
CDR S. S BAIDWAN	Ministry of Defence (DPI) (N), New Delhi
LT-CDR A. BHO MICK (*Alternate*)	
SHRI A. K. BASAK	Development Commissioner, Small Scale Industry, New Delhi
SHRI V. V. R. PRABHU (*Alternate*)	
SHRI H. M. BHATNAGAR	Indian TV Manufacturers Association, New Delhi
SHRI V. K. SETHI (*Alternate*)	
SHRI H. S. CHANDRAMOULI	Bharat Electronics Ltd, Bangalore
SHRI K. RAMASESHU (*Alternate*)	
SHRI R. G. DEODHAR	Wireless Planning and Co-ordination Wing (Ministry of Communications), New Delhi
SHRI M. L. DHAR	Directorate General of Civil Aviation, New Delhi
SHRI P. K. DHINGRA (*Alternate*)	
SHRI A. K. GHOSE	Indian Telephone Industries Ltd, Bangalore
SHRI N. KRISHNAN KUTTY (*Alternate*)	
SHRI B.P. GHOSE	National Test House, Calcutta
SHRI B. C. MUKHERJEE (*Alternate*)	
SHRI J. GUPTA	The Radio Electronic & Television Manufacturers Association (RETMA), Bombay
SHRI T. S. BUXI (*Alternate*)	
SHRI J. GUPTA	Peico Electronics & Electricals Ltd, Bombay
SHRI P. S. SACHDEV (*Alternate*)	
SHRI B. S. GUPTA	Federation of Associations of Small Industries of India, New Delhi
DR S. K. HAJELA	Institution of Electronics and Telecommunication Engineers, New Delhi
SHRI S. JANAKIRAMAN	Directorate of Coordination (Police Wireless), Ministry of Home Affairs, New Delhi
SHRI R. P. MATHUR (*Alternate*)	
LT-COL KRISHAN LAL	Ministry of Defence (DGI), New Delhi
LT-COL B. S. NATRAJAN (*Alternate*)	

(*Continued on page* 2)

(*Continued from page* 1)

Members	*Representing*
Shri R. Lalwani	Posts & Telegraphs Board, New Delhi
Shri V. V. Chaudhary (*Alternate*)	
Shri R. C. Pandey	Ministry of Defence (DTD & P) (AIR), Bangalore
Shri C. M. Krishna Murthy (*Alternate*)	
Shri A. K. N. Prasad	Hindustan Aeronautics Ltd, Bangalore
Shri M. G. Sridharan (*Alternate*)	
Shri W. V Ramana	Electronics Corporation of India Ltd, Hyderabad
Shri K. P. Ramaswamy	Directorate General of Doordarshan, New Delhi
Shri K. B. Borker (*Alternate*)	
Shri P. K. Rangole	Central Electronics Engineering Research Institute, Pilani
Shri H. K. Jain (*Alternate*)	
Shri M. Sankaralingam	Directorate General of Supplies and Disposals, New Delhi
Shri R. S. Arora (*Alternate*)	
Shri S. Sharma	Department of Electronics, New Delhi
Dr K. S. K. Sai (*Alternate*)	
Shri C. G. Subramanyan	Electronics Trade and Technology Development Corporation Ltd, New Delhi
Shri Ishwar Dutt (*Alternate*)	
Shri Suresh Chandra	National Physical Laboratory, New Delhi
Shri K. K. Taneja	Directorate General of Technical Development, New Delhi
Shri H. S. Dubey (*Alternate*)	
Shri C. M. Thirumurthy	Gujarat Communications and Electronics Ltd, Vadodara
Shri N. Srinivasan, Director (Electronics)	Director General, ISI (*Ex-officio Member*)

Secretary

Shri D. K. Nayyar
Assistant Director (Electronics), ISI

Panel for TV Receivers, LTDC 20/P3

Convener	
Shri N. N. Mohanty	All India Radio, New Delhi
Members	
Shri A. S. Guin (*Alternate* to Shri N. N. Mohanty)	
Shri M. L. Arora	M/s Chawla & Company, New Delhi
Assistant Wireless Adviser (Planning-I)	Wireless Planning and Coordination Wing (Ministry of Communication), New Delhi
Shri H. M. Bhatnagar	Indian TV Manufacturers Association, New Delhi
Shri R. B. Lal (*Alternate*)	
Shri R. S. Bhatnagar	Federation of Associations of Small Industries of India Ltd, New Delhi
Shri K. B. Borker	Directorate General of Doordarshan, New Delhi
Shri M. Butchi Raju	Electronics Corporation of India Ltd, Hyderabad
Shri P. Janardhan (*Alternate*)	
Shri R. K. Chakravarti	Department of Electronics, New Delhi
Shri A. Ghaffar	U.P. Electronics Corporation Ltd, Lucknow
Shri S. Janakiram	Information & Public Relations Department, Government of Andhra Pradesh, Hyderabad
Shri K. L. Kandoi	The Radio Electronic and Television Manufacturers Association, Bombay
Shri S. Mitra	Electronic Regional Test Laboratory (North), New Delhi
Shri Inderjeet Banaudha (*Alternate* I)	
Shri C. L. Kaul (*Alternate* II)	
Shri A. Razzaque	Central Electronics Engineering Research Institute, Pilani
Representative	Tamil Nadu Local Administration Radio and Television Manufacturers Organization, Madras
Shri P. K. Sandell	Electronics Trade and Technology Development Corporation Ltd, New Delhi
Shri C. G. Subramanyan (*Alternate* I)	
Shri C. S. Arora (*Alternate* II)	
Shri V. V. R. Sastry	Bharat Electronics Ltd, Bangalore
Shri V. K. Sekhri	Electronic Components Industries Association, New Delhi
Shri Suresh Chandra	National Physical Laboratory, New Delhi
Shri Inderjeet Banaudha (*Alternate*)	

Indian Standard

METHODS OF MEASUREMENT ON RECEIVERS FOR TELEVISION BROADCAST TRANSMISSIONS

PART 3 GEOMETRICAL PROPERTIES OF THE PICTURE

(First Revision)

0. FOREWORD

0.1 This Inidan Standard (Part 3) (First Revision) was adopted by the Indian Standards Institution on 6 December 1983, after the draft finalized by the Radio Communications Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

0.2 The first version of IS : 4545 covered the methods of measurement for television broadcast receivers having monochromes vision reception. With the introduction of colour television receivers, this standard is now being revised to make it applicable to receivers designed for both monochrome and colour vision reception and published in a number of parts to deal with different characteristics of television receivers.

0.3 This standard (Part 3) covers methods of measurements for geometrical properties of the picture. Other parts in this series are:

Part 1 General considerations
Part 2 Tuning properties and general measurements
Part 4 Synchronizing quality
Part 5 Sensitivity
Part 6 Selectivity and response to undesired signals
Part 7 Fidelity
Part 8 Compatibility with audio visual recording equipment
Part 9 Electrical and acoustic measurements at audio frequency

0.4 This standard (Part 3) is largely based on IEC Publication 107-1 (1977) Recommended methods of measurement on receivers for television broadcast transmission: Part 1 General considerations electrical measurements other than those at audio-frequencies, issued by the International Electrotechnical Commission.

0.5 In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

*Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard (Part 3) covers methods of measurement for geometrical properties of the picture, namely:

a) Picture size,
b) Curvature of picture screen,
c) Geometrical distortion,
d) Non-linearity of scanning,
e) Picture outline distortion,
f) Convergence errors,
g) Over and under scanning and centring,
h) Brightness,
j) Contrast, and
k) Brightness transfer characteristic.

1.2 This standard (Part 3) shall be read in conjunction with IS : 4545 (Part 1)-1983*.

2. PICTURE SIZE

2.1 Definitions — The picture size as given by the dimensions of the available picture reproduction area is defined by maximum picture height in centimetres, maximum picture width in centimetres and effective picture area in square centimetres. It is assumed that under standard measuring conditions, the visible part of this area is completely filled with the television picture.

2.2 Method of Measurement — The maximum picture height and width are determined by means of a sliding gauge, cathetometer or other suitable device. To ascertain the effective picture area, a photograph of the picture reproduction area may be taken from a point situated on the optical axis of this area at a distance of ten times the maximum picture height. From this photograph the effective picture area may be determined.

2.3 Presentation of Results — The results shall include a note of which method of measurement has been used. This is because the results obtained by the photographic method are not directly comparable with those obtained by means of a gauge or similar device.

*Methods of measurement on receivers for television broadcast transmissions: Part 1 General considerations (*first revision*).

3. CURVATURE OF PICTURE SCREEN

3.1 Definition — The curvature of the picture screen is defined by the ratio between the picture depth and the maximum picture height or maximum picture width, whichever has the greatest curvature, only the selected one being stated with the result. The picture depth is defined as the distance between two geometrical planes, both perpendicular to the optical axis, one going through the point nearest to the observer and the other going through the most distant points of the visible reproduction area.

3.2 Method of Measurement — The picture depth may be measured with the aid of a travelling microscope or other suitable means.

4. GEOMETRICAL DISTORTION

4.1 Introduction — Any deviation in the reproduced picture from the transmitted signal relationship between time and the coordinates of the picture elements is a geometrical distortion. Geometrical distortions may be dived into three categories as described in **4.2**, **4.3** and **4.4**.

4.2 Influence of Mains Supply Related Effects on Geometrical Distortion — A part of the total geometrical distortion may be caused by effects related to the mains supply. These are most noticeable when the mains supply frequency differs slightly from the field frequency.

4.2.1 *Method of Measurement* — The receiver is operated from a mains supply differing by approximately 1 Hz from the field frequency. The excursion of the points in the picture where the greatest vertical or horizontal displacements are observed is noted and the displacements are measured.

4.2.2 *Presentation of Results* — The displacements measured are expressed as a percentage of the active horizontal or vertical scan periods as appropriate.

4.3 Non-Linearity of Scanning

4.3.1 Distinction is made between horizontal and vertical non-linearity.

Horizontal non-linearity is evaluated by means of the relative deviation of the horizontal velocity of the scanning spot projected orthogonally on to the tangential plane through the centre of the picture reproduction area. The relative deviation is the difference between the instantaneous velocity and the mean velocity, expressed as a percentage of the mean velocity of the scanning spot and is given in graph representing the deviation as a function of time.

Similarly, vertical non-linearity is evaluated by means of the relative deviation of the vertical velocity of the scanning spot.

Both horizontal and vertical non-linearity shall be measured in terms of geometrical distortions along a horizontal and a vertical line approximately through the centre of the picture area.

If the relative phase between the mains supply and the received signal vertical scan synchronization significantly influences the non-linearity of scanning, the measurements shall be made with the test signal generator not locked to the mains supply frequency but with the difference frequency suitably low.

4.3.2 *Method of Measurement* — The vision rf carrier shall be modulated by the appropriate electronically generated video signals as per standards and -50 dB input power shall be fed to the receiver. An electronically generated test pattern may be used consisting of a system of horizontal and vertical lines, both equidistant in time, dividing the picture area into elementary areas of approximately square shape. It is preferable but not essential that these dividing bars themselves be visible but at least the corners of the elementary areas (intersection points of the lines) shall be visible. It is desirable to use at least ten dividing bars because the information given by the measurements increases with the number of dividing bars. If desired, the horizontal and vertical lines may be used separately for these measurements. To ascertain the non-linearity, a photograph of the reproduced pattern may be taken under the same conditions as mentioned in **2.2**.

A cathetometer or other suitable means may also be used as an alternative but only if the picture is sufficiently stable.

The distance between two adjacent intersection points of the projected pattern is used to determine the instantaneous velocity.

The total distance traversed divided by the number of intervals is used to determine the mean velocity.

4.3.3 *Graphic Representation* — The non-linearity is plotted on a linear time scale as abscissa and a linear-percentage scale as ordinate. The equal time intervals corresponding to the divisions of the picture area by the line pattern are marked on the abscissa.

The difference between the instantaneous velocity and the mean velocity is plotted as a percentage of the mean velocity at the centre of each time interval on the abscissa.

In the graph (*see* Fig. 1), short-time non-linearity of scanning such as results from scan ringing, does not necessarily appear. To measure such deviations, a finer pattern may be necessary, but to reduce measurement errors, measurements may be taken over groups of lines.

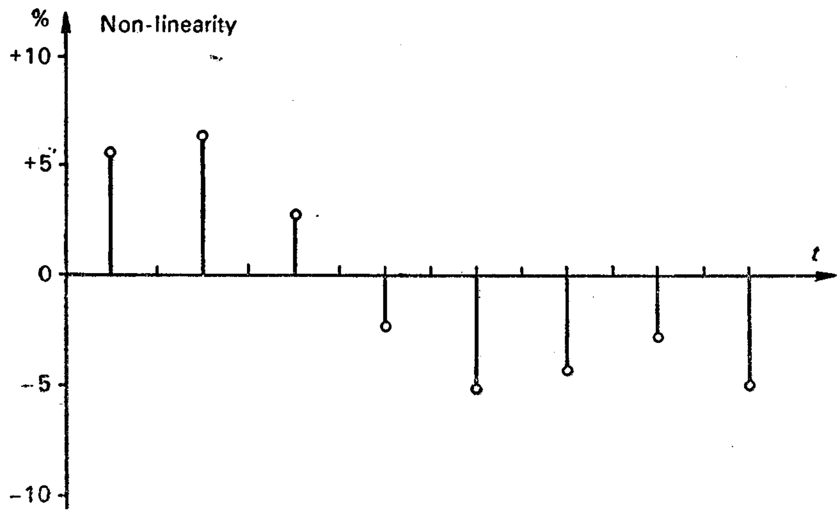


FIG. 1 EXAMPLE OF NON-LINEARITY GRAPH

4.4 Picture Outline Distortion

4.4.1 Picture outline distortions are deviations from a true rectangle of the largest completely visible contour of approximately the correct aspect ratio formed by the test pattern.

4.4.2 *Method of Measurement* — The vision rf carrier shall be modulated by the appropriate electronically generated video signals as per standards and −50 dB input power shall be fed to the receiver. An electronically generated test pattern as described in **4.3.2** may be used.

If desired, the horizontal and vertical lines may be used separately for these measurements. To ascertain the picture outline distortions, a photograph of the reproduced pattern may be taken under the conditions specified in **2.2**.

The distorted reproduction of the contour of the largest completely visible rectangle formed by the test pattern and having approximately the correct aspect ratio is traced (*see* Fig. 2B) or a similar projection of the reproduced pattern on a plane perpendicular to the optical axis.

This contour is normally adequate and shall be reproduced with the results. If one form of distortion predominates, it may be measured in accordance with the following methods.

The corner points *A*, *B*, *C* and *D* are marked and the auxiliary lines *AB*, *BC*, *CD*, *DA*, *KF*, and *HE* are then drawn so that $AE = EB$, $BF = FC$, $CH = HD$ and $DK = KA$ (*see* Fig. 2B).

The distance between *AB* and the point of the contour lying farthest away from *AB* inside the quardrilateral *ABCD* is called a_1.

The greatest distance between the line *AB* and that part of the contour between *A* and *B* lying outside the quardrilateral *ABCD* is called a_2.

The distances b_1, b_2, c_1, c_2, d_1 and d_2 are similarly defined.

It is possible to specify the following distortion percentages:

Horizontal trapezium distortion:

$$T_H = \frac{AD - BC}{AD + BC} \times 100 \text{ percent}$$

and

Vertical trapezium distortion:

$$T_V = \frac{AB - DC}{AB + DC} \times 100 \text{ percent}$$

If the contours *AB* and *DC* lie completely outside the quardrilateral *ABCD*, only a_2 and b_2 may be measured and the

Horizontal barrel distortion:

$$B_H = 2 \times \frac{a_2 + b_2}{AD + BC} \times 100 \text{ percent}$$

If the contours *AB* and *DC* lie completely within the quadrilateral *ABCD*, only a_1 and b_1 may be measured and the

Horizontal pin-cushion distortion:

$$C_H = 2 \times \frac{a_1 + b_1}{AD + BC} \times 100 \text{ percent}$$

Similarly if only c_2 and d_2 may be measured then

Vertical barrel distortion:

$$B_V = 2 \times \frac{c_2 + d_2}{AB + CD} \times 100 \text{ percent}$$

and if only c_1 and d_1 may be measured then

Vertical pin-cushion distortion:

$$C_V = 2 \times \frac{c_1 + d_1}{AB + CD} \times 100 \text{ percent}$$

Parallelogram distortion is expressed by the angle α in degrees,

Ripple distortion of the contour is present when the contours *AB* , *CD*, *BC* and *DA* show undulations (*see* Fig. 2B).

If desired, the peak-to-peak value of such undulations or oscillations may be expressed as a percentage of picture height or width (*see* Fig. 2C, 2D and 2E), the values being taken from the contour reproduction.

Greater distortions of picture outline may occur nearer the centre of the screen than that defined by the largest completely visible rectangle of the test pattern. In this case, the measurements shall be repeated for smaller rectangles and the sizes of all the rectangles used recorded with the results.

Since the picture outline distortion may also be influenced by beam current, additional measurements may be made by increasing the background level of the pattern. The background level or levels used shall be recorded with the results as a percentage of the signal voltage difference between black level and white level.

5. OVERALL GEOMETRICAL DISTORTION ALTERNATIVE METHOD OF MEASUREMENT

5.1 Definition — The measurement procedure provides an overall indication of scanning non-linearity and picture outline distortion. It may be used to give more rapid results than the separate methods described in **4**.

5.2 Method of Measurement — A grill pattern is applied to the receiver having at least 14 horizontal lines and 19 vertical lines.

The vertical lines shall be of approximately sine-squared form with a duration at the half amplitude points of 0·2 to 0·3 μs. The amount of signal drive applied to the picture tube shall be such that any defocusing that may occur does not affect the accuracy of measurement.

Each horizontal line shall consist of a pair of specially adjacent lines, one in each of the pair of interlaced fields.

The peaks of the horizontal and vertical lines shall be at white level and the background normally at black level. In order to ascertain the effect of beam current, the background shall be adjustable in level.

The point of intersection of the horizontal and vertical lines nearest to the geometrical centre of the picture is defined. The mean vertical line spacing is determined by measuring the distance between the second vertical line to the left and the second vertical line to the right of the centre intersection and dividing by 4.

The mean horizontal line spacing is determined in the same way with the second horizontal lines above and below the centre intersection.

Using the mean spacing as a reference, the horizontal displacements of the vertical lines from their theoretically correct positions along all the horizontal lines are measured. The process is then repeated for the vertical scan direction by measuring the vertical displacements of the horizontal lines along all the vertical lines.

The measurements may be conveniently carried out by photographing the pattern. Where the picture is sufficiently stable, measurements may be carried out using a sliding gauge, cathetometer, or other suitable device.

5.3 Presentation of Results — The displacements of the intersections of the pattern are to be expressed as a percentage of the maximum picture width and height respectively. They are to be tabulated identifying the intersections by assigning a pair of coordinates obtained by numbering the lines in the direction of scan, the first representing the vertical scan direction and the second, the horizontal scan direction (*see* Fig. 2F).

6. CONVERGENCE ERRORS (NOT APPLICABLE TO MONOCHROME TV RECEIVERS)

6.1 Definition — Convergence errors are the extent to which all three electron beams of a colour display tube fail to converge upon a common phosphor triad over the entire screen area.

6.2 Method of Measurement — An rf signal modulated by grill pattern having at least 14 horizontal lines and 19 vertical lines at power level of —50 dB is applied to the receiver.

The vertical lines shall be of approximately sine-squared form with a duration at the half amplitude points of 0·2 to 0·3 μs. The amount of signal drive applied to the picture tube shall be such that any defocusing that may occur does not affect the accuracy of measurement.

Each horizontal line shall consist of a pair of specially adjacent lines, one in each of the pair of interlaced fields.

The background of the patterns shall be at black level and the peaks of both horizontal and vertical lines shall be at white level.

The vertical and horizontal separation between the red and green components and the vertical and horizontal separation between the blue and green components is measured along the vertical and horizontal lines at their intersection (*see* Fig. 2F).

6.3 Presentation of Results — The results are to be tabulated for:

a) red/green horizontal error,

b) red/green vertical error,

c) blue/green horizontal error, and

d) blue/green vertical error.

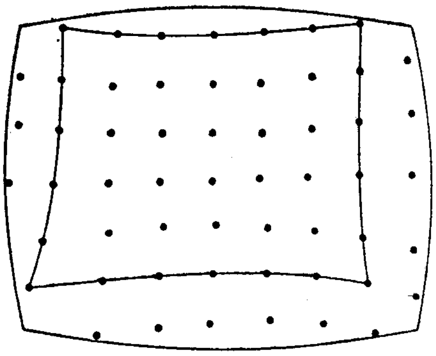


FIG. 2A TEST PATTERN FOR PICTURE OUTLINE DISTORTION MEASUREMENTS SHOWING PIN-CUSHION DISTORTION

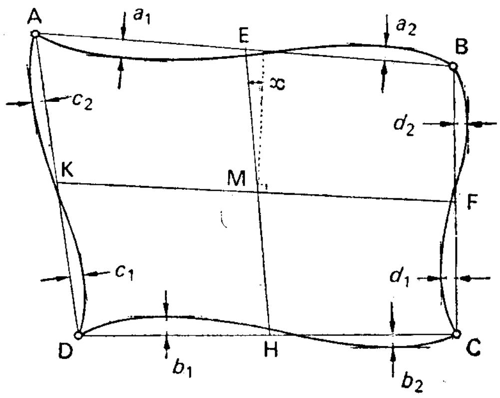


FIG. 2B DIAGRAM FOR ASSESSING PICTURE OUTLINE DISTORTION VALUES

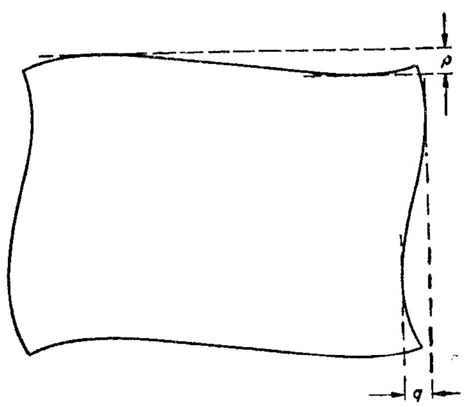


FIG. 2C UNDULATIONS IN THE HORIZONTAL SCAN (p) AND THE VERTICAL SCAN (q)

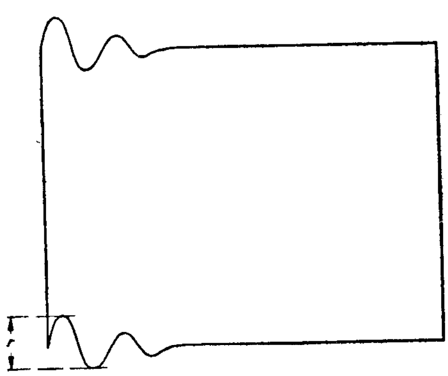


FIG. 2D OSCILLATIONS IN THE HORIZONTAL SCAN (r)

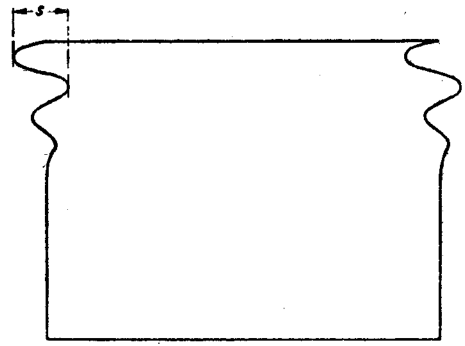


FIG. 2E OSCILLATIONS IN THE VERTICAL SCAN (s)

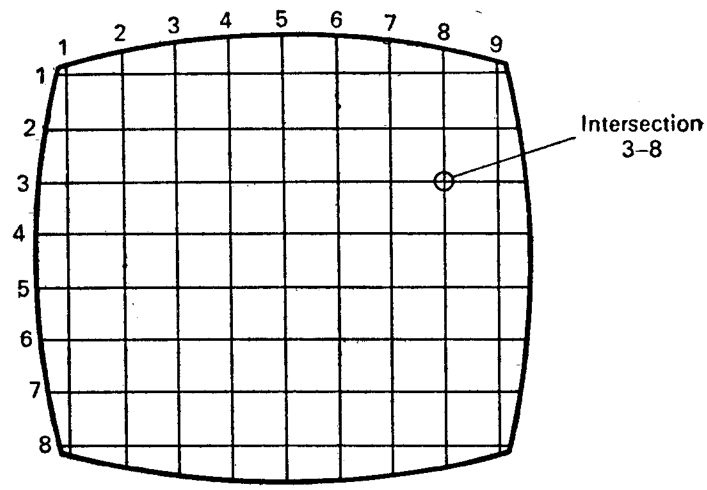
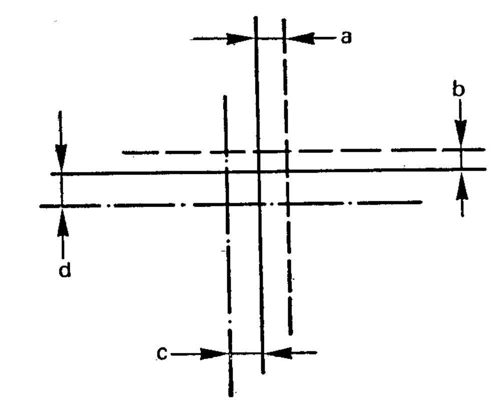


FIG. 2F (a) TEST PATTERN FOR MEASUREMENT CONVERGENCE ERRORS



——Screen: a = red/green horizontal error
......red: b = red/green vertical error
——blue: c = blue/green horizontal error
d = blue/green vertical error

FIG. 2F (b) MEASUREMENT OF CONVERGENCE ERRORS

The separations measured are expressed as a percentage of maximum picture width and related to the appropriate intersection. The intersections may be identified by assigning a pair of coordinates obtained by numbering the lines in the directions of scan, the first representing the vertical scan direction and the second, the horizontal scan direction (*see* Fig. 2F).

7. OVER AND UNDER-SCANNING AND CENTRING

7.1 Definition — The displayed picture area may not correspond with the total active picture of the applied signal, some parts being obscured due to over-scanning. Alternatively, the displayed picture may not entirely fill the available screen area due to under-scanning.

7.2 Method of Measurement — An electronically generated test pattern may be used consisting of a system of horizontal and vertical lines both equidistant in time dividing the picture into elementary area of approximately square shape. One vertical and one horizontal line shall correspond with the mid-points of the active picture period and means shall be included to identify the centre of the picture as represented by the intersection of these two lines. The number of lines included in the pattern depends upon the required accuracy of measurement.

The centre of the screen area is derived from the maximum picture height and width, determined as in **12.** The separation of the mid-point of the pattern from the centre of the screen and the amounts of over-and under-scanning are measured on the horizontal and vertical scanning axes.

7.3 Presentation of Results — The over and under-scanning, also the displacement of the centre of the picture, are plotted on line diagrams for the horizontal and vertical scanning axes expressed as a percentage of the maximum picture height and width (*see* Fig. 3).

NOTE 1 — This measurement may be carried out over a range of power supply voltages as described in **5** of IS : 4545 (Part 1) - 1983*.

NOTE 2 — This measurement shall be repeated using a range of adjustments of the appropriate user controls.

NOTE 3 — This measurement may be carried out using picture content having low, medium and high average values.

8. BRIGHTNESS

8.1 Factors limiting the useful brightness of a television picture for a specified set of conditions of use are:

a) the maximum brightness available under the specified conditions,

b) limitation due to geometrical distortion,

c) limitation due to deterioration of focus, and

d) limitation due to flicker.

Factors (a), (b) and (c) may vary with the setting of the controls. Since the black level is usually adjusted to approximate to the ambient illumination reflected from the picture screen, it is desirable to measure the maximum brightness for black level settings, corresponding to typical values of ambient illumination for which the receiver is designed. The factors (a), (b) and (c) also depend on the area of the picture at peak white level.

Highlight flicker is related to the brightness decay time of the screen material (*see* **8.3**).

8.2 Maximum Highlight Brightness Characteristics

8.2.1 *Definition* — Maximum highlight brightness is the highest luminance value that can be measured at the screen for a stated black level when the signal described below is applied to the receiver.

8.2.2 *Method of Measurement* — The input shall be a television signal with test card modulation at a level of — 50 dB (mW). The black level output shall be set at levels of 1, 3 and 10 nits successively by means of the brightness control. The contrast control shall be advanced in steps from minimum to maximum for each setting of black level and the peak white output measured at each step until no further increase in brightness occurs. The focus and synchronization controls shall be adjusted for best possible performance. If by means of adjustment of other controls, such as sensitivity, a further increase in brightness may be obtained, this shall be noted and measured.

8.2.3 *Graphic Representation* — For each of the specified black levels, the peak white luminance values are plotted on a linear scale as ordinate and arbitrary units of contrast control setting as abscissa. An example is given in Fig. 4.

Where applicable, on each curve, an indication shall be made at which it is considered the brightness is just usable and limited by distortion and/or loss of focus. The criterion of distortion or loss of focus employed shall be indicated with the results. If, in the course of observation, other deleterious effects take place, these shall be noted.

NOTE — If it is suspected that the EHT regulation affects the brightness, the brightness measurements in **8.2** shall be repeated using a pattern containing a large area at peak white.

*Methods of measurement on receivers for television broadcast transmissions: Part 1 General considerations (*first revision*).

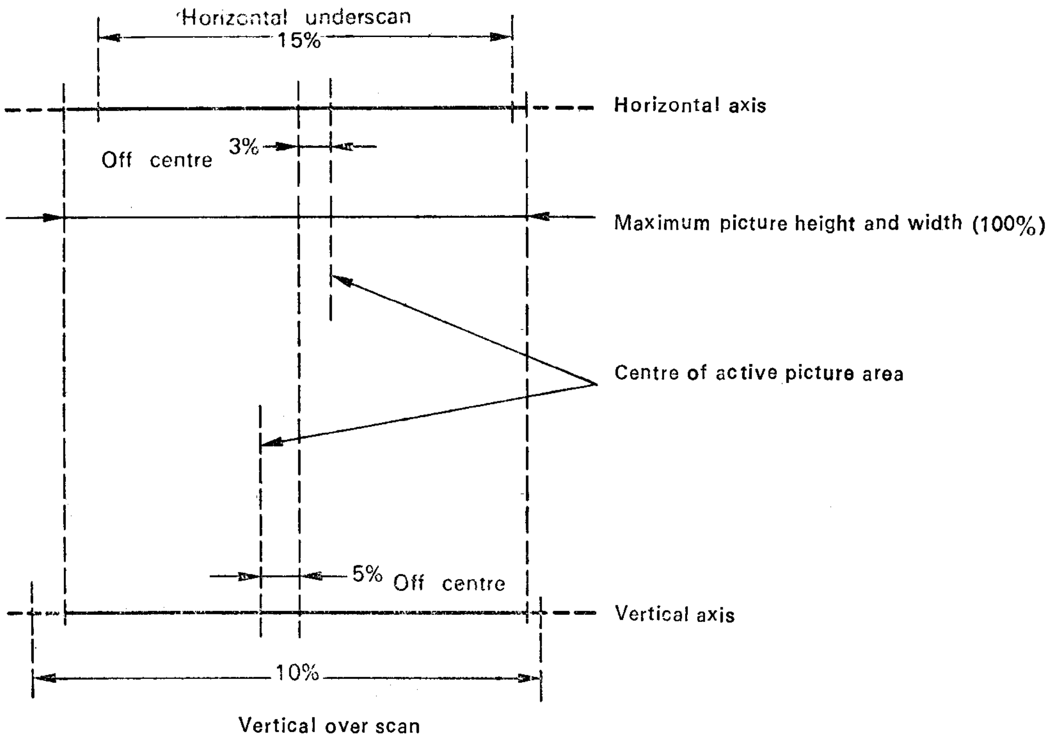
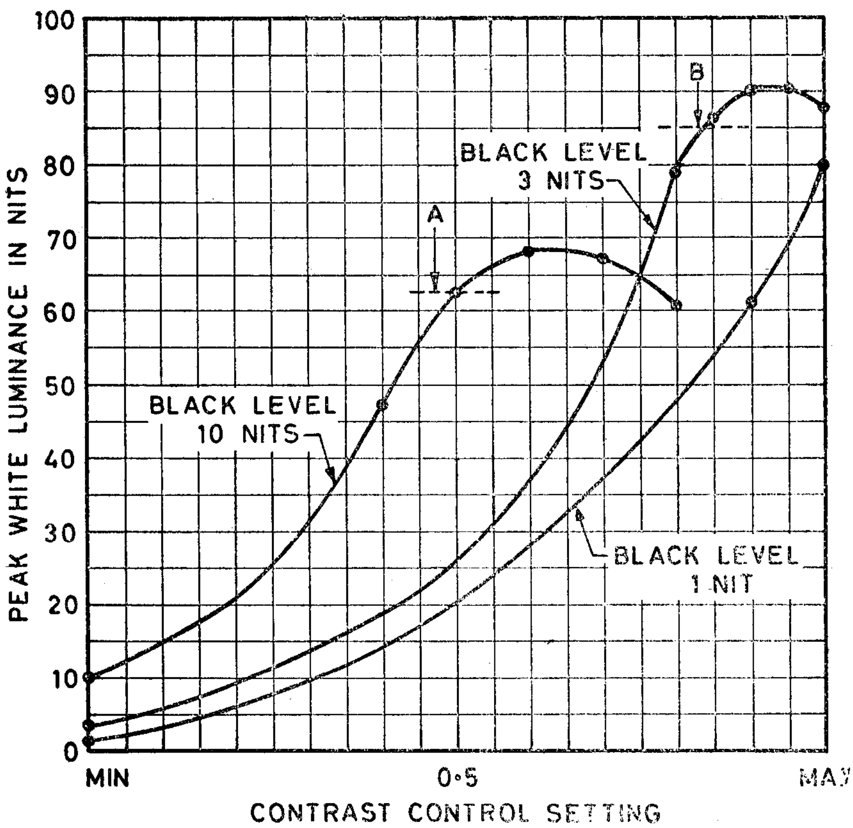


FIG. 3 EXAMPLE OF OVER- AND UNDER-SCANNING AND CENTRING



A = picture distortion (10% vertical expansion)
B = loss of focus (3 MHZ bars no longer resolved)

FIG. 4 MAXIMUM HIGHLIGHT BRIGHTNESS CHARACTERISTICS

8.3 Brightness Decay Characteristic — The high-light brightness, where flicker becomes objectionable, is related to the brightness decay characteristic of the phosphor. The decay characteristic shall therefore be measured or taken from the data of the picture tube manufecturer.

9. CONTRAST

9.1 Definition — Contrast is the ratio of the luminance of a peak white area of the picture screen to the luminance of a black area of the picture screen.

9.2 Halation-Limited Contrast — The halation-limited contrast depends on the following factors:

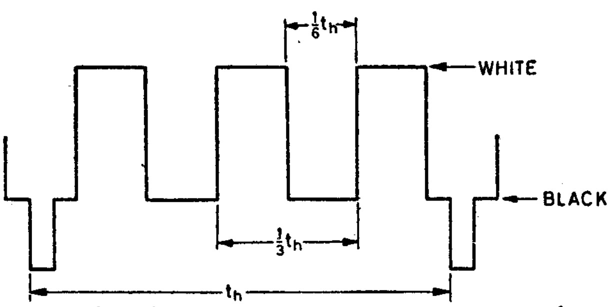
a) Relative size of black and white areas. In general, the contrast deteriorates as a greater portion of the tube screen is excited by electrons.

b) Points where luminance is measured. In general, the contrast deteriorates as these points approach each other.

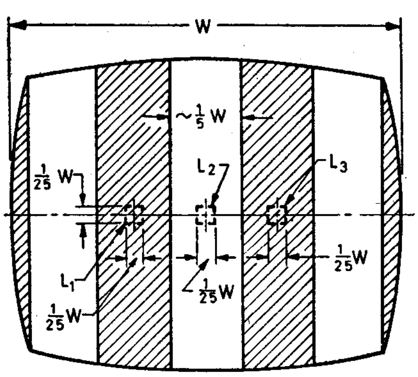
9.3 Halation-Limited Large Area Contrast

9.3.1 *Definition* — Halation-limited large area contrast is the maximum contrast measured using a pattern consisting of broad black and white vertical bars, as described in **9.3.2**.

9.3.2 *Method of Measurement* — The signal used and the pattern produced on the screen are shown in Fig. 5A and 5B. The tube beam-current shall be cut off in the black areas of the picture.



5A Modulation waveform for Measurement of Halation-Limited Large Area Contrast



5B Test Pattern for Measurement of Halation-Limited Large Area Contrast

FIG. 5 HALATION-LIMITED LARGE AREA CONTRAST

The luminance of the white areas of the picture shall be sufficiently high to facilitate the measurement. The luminance values L_1, L_2, L_3 of the three square areas indicated in the figure are measured without ambient illumination of the screen. If necessary, a mask, leaving free the required area, may be used with the luminance meter. The halation-limited large area contrast is given by:

$$\alpha_1 = \frac{2L_2}{L_1 + L_3}$$

9.4 Halation-Limited Detail Contrast

9.4.1 *Definition* — Halation-limited detail contrast is the maximum contrast measured using a pattern consisting of one small black area on a white field, as described in **9.4.2**.

9.4.2 *Method of Measurement* — The pattern used is shown in Fig. 6. The beam-current shall be out off in the small black area is the centre of the picture. The luminance of the white area shall be sufficiently high to facilitate the measurement.

The luminance values L_1, L_2, L_3, L_4 and L_5 of the five areas indicated in the figure shall be measured without ambient illumination on the screen. If necessary, a mask, leaving free the required area, may be used with the luminance meter. When L_1 is measured, the instrument or the mask shall be moved about slightly to obtain a minimum reading.

The halation-limited detail contrast is given by:

$$\alpha_d = \frac{L_2 + L_3 + L_4 + L_5}{4L_1}$$

The halation-limited detail contrast may be different in the corners of the picture and it may be desirable to repeat the measurement in at least one corner with a suitably modified pattern.

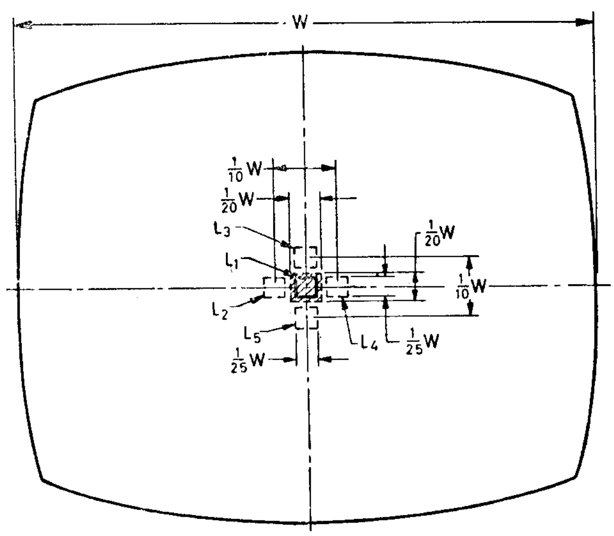


FIG. 6 TEST PATTERN FOR MEASUREMENT OF HALATION-LIMITED DETAIL CONTRAST

9.5 Maximum Usable Detail Contrast

9.5.1 *Definition* — The maximum usable detail contrast is the ratio of the maximum usable highlight brightness for a stated black level, and the brightness of the black level for specified conditions of measurement.

9.5.2 *Method of Measurement* — The method of measurement indicated in **8.2.2** shall be used.

9.5.3 *Graphic Representation* — Contrast is plotted on a linear scale as ordinate for each black level and arbitrary units of contrast control setting as abscissa. An example is given in Fig. 7.

9.5.4 *Limiting Factors* — Corresponding indications are made as detailed in **8.2.3**.

9.6 Contrast with Ambient Illumination — The contrast is adversely affected by ambient illumination on the screen. The luminance values of the black and white parts of the picture are increased by an equal amount. If, without ambient illumination, the luminance of the black part is L_b and the luminance of the white is L_w, then the large-area contrast is:

$$\alpha_1 = \frac{L_w}{L_b}$$

With ambient illumination an amount L_r shall be added to both L_b and L_w.

L_r being the luminance due to ambient light reflected by the picture screen:

$$L_r = \rho L_o$$

where

ρ = reflection coefficient of the picture screen (*see* **9.7**), and

L_o = luminance that would be caused by the ambient illumination with $\rho = 1$.

The contrast with ambient illumination then becomes:

$$\alpha_1 = \frac{L_w + L_r}{L_b + L_r} = \frac{L_w + \rho L_o}{L_b + \rho L_o}$$

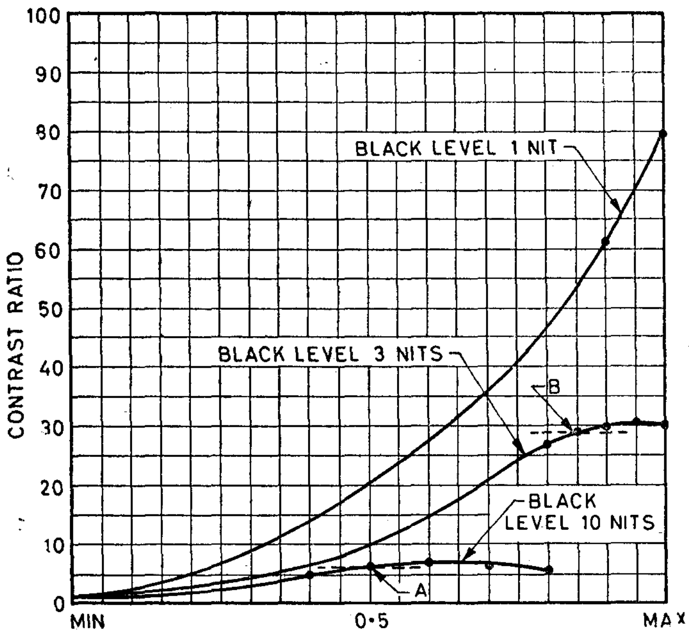
9.7 Reflection Characteristic of the Picture Screen

9.7.1 *Definition* — The reflection characteristic of the picture screen is the ratio of the luminance value measured in the direction of the optical axis to that of an ideally diffusing surface measured under exactly the same conditions as a function of the angle of incidence of the ambient illumination, the receiver being switched off.

9.7.2 *Method of Measurement* — The front of the receiver shall be illuminated by a source of light equivalent to standard illuminant C* (Standard illuminant C corresponds to a black-body temperature of about 6 500° K). The receiver shall not be operating. A magnesium carbonate block shall be placed on the optical axis in contact with and in front of the optical surface nearest the viewer. The luminance values of the magnesium carbonate block and the face of the receiver adjacent to the carbonate block shall be measured, varying the angle of incidence of the ambient illumination.

9.7.3 *Expression of Results* — The result shall be expressed as the ratio between the

*As defined by the International Commission on Illumination, Report 1931.



A = picture distortion (10 % vertical expansion)
B = loss of focus (MHz bars no longer resolved)

FIG. 7 MAXIMUM USABLE DETAIL CONTRAST CURVES

luminance of the face of the receiver and that of the magnesium carbonate block corrected for its known reflectance.

9.8 Directional Characteristie of the Picture Screen

9.8.1 *Definition* — The directional characteristic of a particular point of the picture screen represents the relation between the angle of observation relative to the optical axis and the ratio of the luminance at that point, observed in that direction, to its luminance observed along the optical axis. The measurement is made in the absence of ambient illumination. This characteristic gives information of the usable angle of observation.

10. DEFINITION AND FOCUS

10.1 Definition — The vertical and the horizontal definitions are expressed as the maximum number of lines which can be resolved in the vertical and the horizontal directions as read from the definition wedges on a reproduction of the standard test card.

10.2 Method of Measurement — The receiver shall be set up for standard image or standard video output voltage with standard test card modulation. The definition in the corners and the centre of the screen shall be read from the definition wedges of the test card reproduction.

The values found depend on the focus setting. The definition in the corners may not be a maximum when the focus is set for best definition in the centre, and also the vertical definition may not be a maximum when the focus is set for best horizontal definition. Before the definition is read, the focus shall be adjusted in such a manner that the best overall compromise is obtained.

11. BRIGHTNESS TRANSFER CHARACTERISTIC

11.1 Definition — The brightness transfer characteristic represents the relationship between the luminance and the corresponding picture modulation percentage for various parts of the picture.

11.2 Method of Measurement — A television signal of level — 50 dB (mW), modulated with a step pattern consisting of vertical bars, shall be applied to the receiver input terminals. The steps of the signal shall preferably cover the range in approximately 10 equal steps from 3 to 100 percent picture modulation (*see* Fig. 8). The mean level of the modulation then corresponds to approximately 50 percent. The controls of the receiver shall be set so that 3 percent modulation corresponds to each of the black levels stated in **8.2** and 100 percent picture modulation corresponds to the related maximum usable highlight brightness (*see* **8.2.3**). The luminance at each level of the step waveform shall be measured.

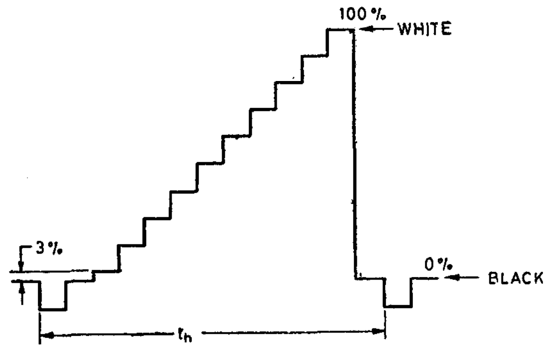


FIG. 8 MODULATION WAVEFORM FOR BRIGHTNESS TRANSFER CHARACTERISTIC

11.3 Graphic Representation — The brightness transfer characteristic shall be plotted on a logarithmic picture modulation percentage scale as abscissa and a logarithmic luminance scale as ordinate for each value of stated black level and corresponding maximum usable highlight brightness (*see* Fig. 9).

The slope at any point of this curve is called the gradation.

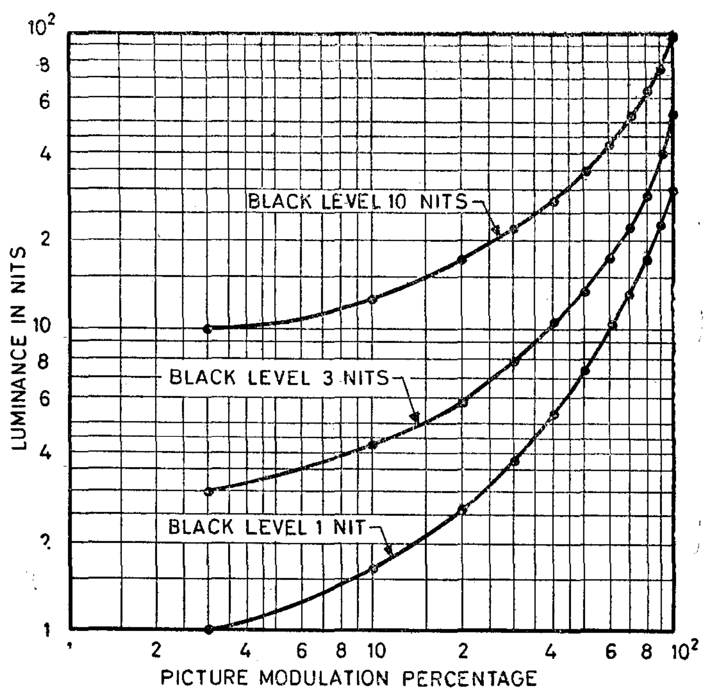


FIG. 9 BRIGHTNESS TRANSFER CHARACTERISTICS

INDIAN STANDARDS INSTITUTION

Headquarters:
Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002
Telephones : 331 01 31, 331 13 75 Telegrams: Manaksanstha
(Common to all offices)

Regional Offices:	*Telephone*
*Western : Manakalaya, E9 MIDC, Marol, Andheri (East), BOMBAY 400093	6 32 92 95
†Eastern : 1/14 C.I.T. Scheme VII M, V.I.P. Road, Maniktola, CALCUTTA 700054	36 24 99
Northern : SCO 445-446, Sector 35-C, CHANDIGARH 160036	2 18 43 3 16 41
Southern : C.I.T. Campus, MADRAS 600113	41 24 42 41 25 19 41 29 16
Branch Offices :	
'Pushpak', Nurmohamed Shaikh Marg, Khanpur, AHMADABAD 380001	2 63 48 2 63 49
'F' Block, Unity Building, Narasimharaja Square, BANGALORE 560002	22 48 05
Gangotri Complex, 5th Floor, Bhadbhada Road, T. T. Nagar, BHOPAL 462003	6 67 16
Plot No. 82/83, Lewis Road, BHUBANESHWAR 751002	5 36 27
53/5 Ward No. 29, R.G. Barua Road, 5th Byelane, GUWAHATI 781003	—
5-8-56C L.N. Gupta Marg (Nampally Station Road), HYDERABAD 500001	22 10 83
R14 Yudhister Marg, C Scheme, JAIPUR 302005	6 34 71 6 98 32
117/418B Sarvodaya Nagar, KANPUR 208005	21 68 76 21 82 92
Patliputra Industrial Estate, PATNA 800013	6 23 05
Hantex Building (2nd Floor), Railway Station Road, TRIVANDRUM 695001	52 27
Inspection Office (With Sale Point):	
Institution of Engineers (India) Building, 1332 Shivaji Nagar, PUNE 411005	5 24 35

*Sales Office in Bombay is at Novelty Chambers, Grant Road, Bombay 400007 89 65 28
†Sales Office in Calcutta is at 5 Chowringhee Approach, P. O. Princep Street, Calcutta 700072 27 68 00

Printed at Swatantra Bharat Press, Delhi, India